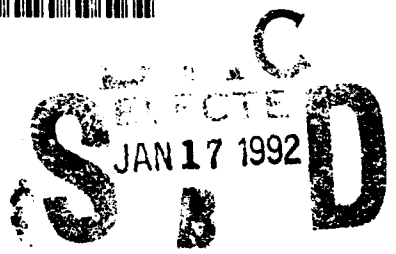
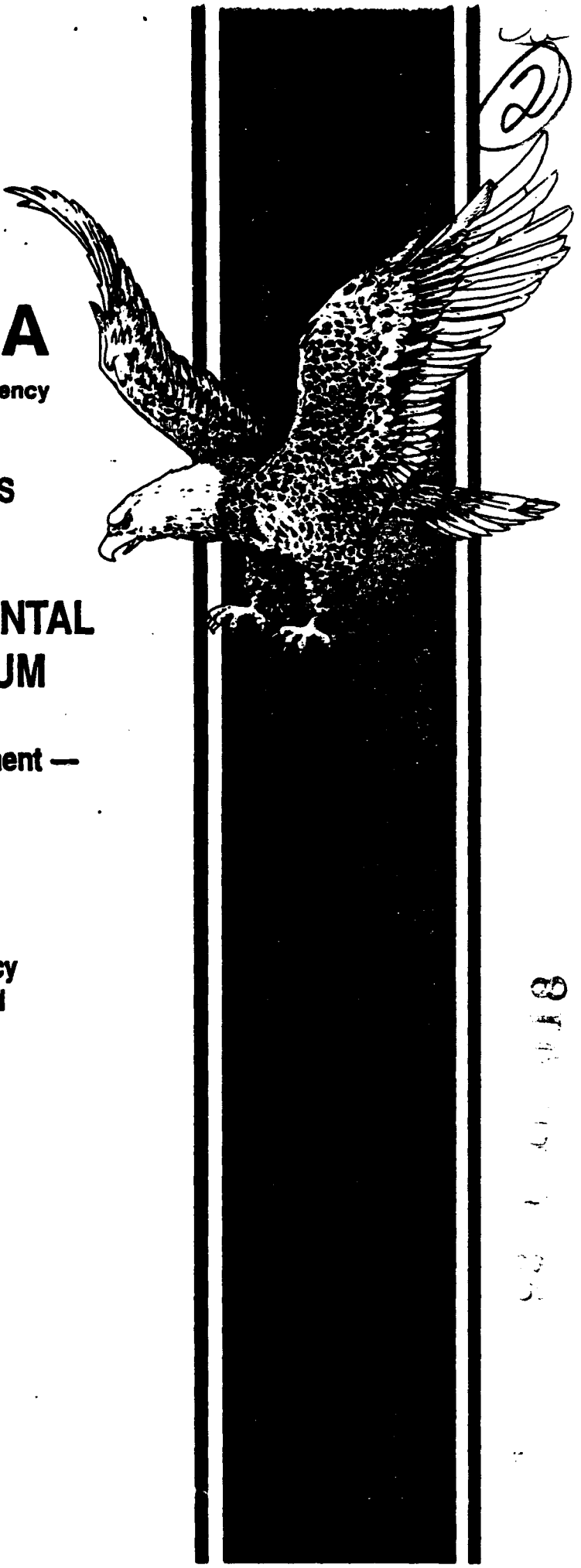


USATHAMA

U.S. Army Toxic and Hazardous Materials Agency



SUPPLEMENTAL PROCEEDINGS FOR THE

13TH ANNUAL ENVIRONMENTAL QUALITY R&D SYMPOSIUM

"Working Towards a Better Environment — A Progress Report"

Hosted By:
United States Army
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This symposium is a significant means of technology exchange of the Army's R&D program. It is designed to facilitate developer/user interface by joint participation. This annual event involves key personnel from all pertinent Federal agencies and provides a forum where users are given the opportunity to benefit from the perspectives of senior DOD leadership. This report provides supplemental proceedings from the symposium.

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Foreword

This symposium is a significant means of technology exchange for the Army's R&D program. It is designed to facilitate developer/user interface by joint participation. This annual event involves key personnel from all pertinent Federal agencies and provides a forum where users and devlopers are kept abreast of latest state-of-the-art technologies and are given the opportunity to benefit from the perspectives of senior DOD leadership.

These supplemental proceedings contain papers which were presented at the symposium and are in addition to the proceedings previously published.

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THE USAEHA SYNTHETIC ORGANIC CHEMICALS SURVEY (SOCS)

Kathleen W. Simmers*
Robert J. Valis
K. K. Phull

SUMMARY

The Synthetic Organic Chemicals Survey (SOCS) of all Army drinking water wells is being conducted by the U.S. Army Environmental Hygiene Agency (USAEHA) to supplement existing U.S. Army Toxic and Hazardous Materials Agency (THAMA) ground water quality data and detect potential drinking water quality problems. This proactive survey, using state-of-the-art analytical methodologies, is providing baseline data for many uses. Data obtained from the survey to date have confirmed reports of contamination from past activities and shown that additional contamination sites may exist.

BACKGROUND

The U.S. Environmental Protection Agency (EPA) currently regulates 16 synthetic organic chemicals (SOCs) in drinking water, and requires the monitoring of up to 51 additional SOCs. Four pesticides were the first SOCs regulated. The regulations were published on 24 December 1975, and applied to all community water systems (all public water systems which serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents). Four years later, on 29 November 1979, four trihalomethanes were regulated as a group. This regulation applied only to community water systems which served more than 10,000 people and added a disinfectant during the treatment process. The regulations published last year (8 July 1987) established maximum contaminant limits (MCLs) for eight volatile organic chemicals (VOCs) and monitoring requirements for at least 34 and up to 51 additional VOCs. The regulations applied to both community water systems and non-transient, non-community water systems (NTNC) (systems which regularly serve the same 25 or more people at least 6 months of the year). In addition to these chemicals which are currently regulated, the 1986 amendments to the Safe Drinking Water Act required EPA to regulate additional SOCs by June 1989 and to provide a list of priority drinking water pollutants which may require regulation. The lists of additional SOCs to be regulated and the priority drinking water pollutants were provided in the 22 January 1988 edition of the Federal Register. Appendix A presents a summary of all currently regulated or monitored SOCs in drinking water, and all those which have been proposed for regulation.

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* Note about the authors:
Ms. Simmers - Environmental Engineer, Water Quality Engineering Division, Directorate of Environmental Quality, USAEHA.
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MAJ Phull - Chief, Water Resources Surveillance Branch, Water Quality Engineering Division, Directorate of Environmental Quality, USAEHA.

The USAEHA initiated a Drinking Water Surveillance Program (DWSP) at all Army installations in 1972, which was expanded to include the pesticides and trihalomethanes when those regulations were passed. The DWSP monitored the treated water quality in the installation distribution systems, as required by EPA. About 35 installations were large enough to require trihalomethane monitoring. When the EPA first published the final rule regulating eight VOCs on 8 July 1987, the majority of water systems at Army installations had never been tested for any VOCs.

PURPOSE OF THE SURVEY

The current USAEHA SOCS was initiated in December 1986. It is not connected with the DWSP, and is being conducted in conjunction with, and funded by, THAMA. The survey was designed to provide data for two primary purposes:

a. Supplement existing THAMA data on aquifer quality.

b. Detect potential drinking water quality problems.

The ground water monitoring usually performed by THAMA at installations is directly connected to hazardous waste site monitoring. The monitoring wells are usually in shallow aquifers in the immediate area of the waste sites, and the samples are analyzed for chemicals of concern in hazardous waste management. The SOCS, on the other hand, examined existing drinking water wells. Drinking water wells are generally in deep aquifers, and located in areas away from hazardous waste sites or sites where past activities may have included work with hazardous materials. The SOCS samples were analyzed for chemicals of concern in both hazardous waste management and drinking water. In addition, an attempt was made to identify any other volatile or semivolatile organic chemicals which were detected during the analytical procedures. The detection of any organic chemicals in the well samples could indicate that either:

a. Shallow aquifer contamination had migrated into the deeper aquifer;

b. That a previously unknown source of contamination existed at the installation or;

c. That contamination was migrating from an outside source onto the installation.

The detection of any organic chemicals in the well samples may also indicate a potential drinking water quality problem at the installation. Acceptable levels of contamination for most organic chemicals in drinking water have not been established; in fact, there are no health effects data at all for many of the chemicals. However, high levels of any organic chemical in a drinking water well indicates that treatment to remove the chemical should be investigated, or an alternate source of drinking water considered. Low levels of contamination may indicate a need for periodic monitoring to ensure that levels do not increase.

It had been anticipated that the data from the SOCS could be used to satisfy the first round of EPA-required VOC monitoring, as established in the 8 July 1987 Federal Register. However, the correction of the Final Rule, which was

published in the 1 July 1988 Federal Register, indicates that all EPA samples must be taken after any treatment provided to the well water. Army regulations require that all drinking water be chlorinated.* The SOCS samples were specifically taken at the wellhead, before any treatment, to provide a measure of aquifer quality. The wellhead samples should provide a "maximum contaminant concentration" for every chemical except the trihalomethanes. Chlorination may increase the concentrations of trihalomethanes; every other chemical monitored will generally either be reduced or remain unchanged by any treatment which is provided to the drinking water (assuming that no contamination is introduced from the chemicals used in treatment). The individual State regulators will have to determine if the SOCS data are acceptable to fulfill the VOCs monitoring requirement.

SCOPE OF THE SURVEY

The survey encompasses all Army installations in the United States, including Alaska and Hawaii. Approximately 630 wells, which are used to supply drinking water, are to be surveyed. This includes wells which are used on a full time basis, those which are used intermittently (such as wells located at training areas or recreational areas) and those which are maintained on a standby basis for use in emergencies. There are about 85 Army installations which obtain some portion of their drinking water from ground water wells.

The order in which installations were surveyed was generally determined by the perceived risk of ground water contamination in the drinking water aquifer at the installation. Those installations at which some aquifer contamination had previously been detected were sampled first, followed by those installations at which activities were occurring or had occurred in the past which could have caused contamination.

The purpose of the SOCS is to provide a very comprehensive scan of drinking water quality from wells, which can be used by a number of different organizations for various purposes. The final list of specific chemicals which would be analyzed was developed from a number of different sources. A preliminary list was created by integrating the list of hazardous waste priority pollutants, with the list of chemicals which were currently monitored or had ever been proposed for monitoring in drinking water, and a list of Army-specific chemicals of concern in groundwater. The preliminary list was then reviewed to determine which EPA Method or Water/Wastewater Standard Method of analysis could be used for each chemical.

Chemicals were added to the preliminary list for the following reasons:

a. Multianalyte procedures were used. If chemicals were normally detected during the procedure, they were added to the list.

*Army Regulation 40-5, Preventive Medicine, 30 Aug 86.

b. Generic classes of chemicals can not be analyzed. The preliminary list included the generic classes of PAH's, PCB's, and phthalates. The list was expanded to ensure that a range of specific chemicals within each generic class was included. Table 1 shows the classes, and specific chemicals which were analyzed within each class.

TABLE 1. GENERIC CLASSES AND SPECIFIC CHEMICALS IN EACH CLASS

PAH's	PCB's	PHTHALATES
Acenaphthene	1016	Butyl benzyl phthalate
Acenaphthylene	1221	Diethyl phthalate
Anthracene	1232	Dimethyl phthalate
Benzo(a)anthracene	1242	Di-n-butyl phthalate
Benzo(a)pyrene	1248	Di-n-octyl phthalate
Benzo(ghi)perylene	1254	Bis-2-ethylhexyl phthalate
Benzo(b)fluoranthene	1260	
Benzo(k)fluoranthene		
Chrysene		
Dibenzo(a,h)anthracene		
Fluoranthene		
Fluorene		
Indeno(1,2,3-cd)pyrene		
Naphthalene		
Phenanthrene		
Pyrene		

Chemicals were deleted from the preliminary list for the following reasons:

a. No satisfactory method was available for the analysis of the following:

(1) Di(2-ethylhexyl) adipate. This compound is the only one currently of interest within the generic class "adipates". EPA evaluation of an analytical method for the compound is just beginning.* However, the chemical should be detected during the SOCS scan for additional semivolatile compounds. The compound is a plasticizer used in the manufacture of PVC pipe.

(2) Acrylamide and epichlorohydrin. Workable methods for the determination of these compounds in water have not yet been achieved.* They are contaminants found in polymeric coagulants occassionally used in the water treatment processes. The majority of the Army's drinking water wells receive only chlorination treatment, and would not be exposed to these chemicals.

(3) Diquat, endothall and glyphosate. EPA methods development and applications work is presently being conducted on these compounds.* Diquat and endothall are herbicides which are used occasionally, while the herbicide glyphosate is used frequently at Army installations.

* Analytical Methods for Synthetic Organic Chemicals - An Overview, James J. Lichtenberg and James E. Longbottom, EPA Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

b. The cost of analysis was considered too high for the value of the data which would be received for the following:

(1) Aldicarb, aldicarb sulfone, aldicarb sulfoxide, carbofuran, and vydate. The cost for the analysis of these five carbamate compounds was approximately $200 per sample. The chemicals are agricultural pesticides. They are not used by the Army, and the only possible occurrence on Army installations would be on land which is outleased for agricultural purposes.

(2) 2,3,7,8-TCDD (Dioxin). The cost for the analysis was estimated at $500-$1000 per sample. There is considerable controversy as to whether it has ever been found in groundwater samples. The detection of compounds such as 2,4,5-TP, 2,4,5-T, 2,4-D, or PCB's in a sample indicates that dioxins may be present at a site. If any of these chemicals are detected during the SOCS, an analysis for dioxin will be performed.

c. There was no capability to analyze for the compounds dinoseb, dalapon and picloram, either inhouse or by existing contract laboratories. These are herbicides, and could have been used on Army installations. Dinoseb was used in the past, but is no longer available. Dalapon and picloram are currently in use.

d. Appendix B presents the final list of analytes for the SOCS, along with a summary of the information presented in this section. The preliminary list of chemicals is given along with the source list and the analytical method used for each chemical. Any additions or deletions to the preliminary list are noted.

SAMPLING AND ANALYTICAL PROCEDURES

Sampling for the SOCS is being performed by installation personnel. Each installation provided USAEHA with a designated point of contact (POC) for the survey. Arrangements for taking the samples are made by the installation POC. Sampling containers and the required preservatives are prepared by USAEHA and shipped to the installation with instructions for sampling, packaging and return shipment. The samples are taken at the wellheads through the normal pump and plumbing system, before any treatment of the water occurs. Only wells which are operational are being tested at this time. Other wells will be sampled when they are repaired and brought on line. The water samples are packed in ice and shipped next-day-express to the USAEHA laboratory.

The water samples collected are tested using a series of analytical methods. These include:

a. Target volatile organic compounds - EPA Method 524.2.

b. Target semivolatile organic compounds - EPA Method 625.

c. Chlorinated pesticides - EPA Method 608.

d. Explosives - USAEHA Method 12.1.

e. Chlorinated herbicides - Water/Wastewater Standard Method 509.

f. Additional volatile compounds - review of EPA Method 524.2 data tapes.

g. Additional semivolatile compounds - review of EPA Method 625 data tapes.

h. Additional herbicides - USAEHA Method 33.1 (based on EPA National Pesticide Survey Method 1).

A key element of the extensive analysis of the SOCS samples is measurement of the VOCs. Volatile organics have been found to be major ground water contaminants. EPA Method 524.2 was selected to measure the VOCs. It is a state-of-the-art capillary gas chromatographic/mass spectrometric (GC/MS) procedure, which monitors for over fifty volatile organics at a 0.5 part per billion detection level. The procedure also is capable of detecting and identifying numerous other species, including 4 additional specific materials not normally monitored in the method but on the SOCS survey list, using examination of mass spectral data files. Any unknown peaks detected are compared against a mass spectral library data base for tentative identification.

A similar GC/MS procedure (EPA Method 625) monitors for a large number of less volatile SOCs, as well as 7 additional specific materials not typically screened for in the methodology. Again, any unknown peaks detected are compared against a mass spectral library data base for tentative identification.

CURRENT STATUS OF PROGRAM

As of October 1988, approximately 510 drinking water wells had been surveyed. Initial sampling at all 37 U.S. Army Materiel Command (AMC) installations have been completed, along with 21 of the 27 U.S. Forces Command (FORSCOM) installations and the 5 U.S. Army Western Command (WESTCOM) installations in Hawaii. Confirmatory sampling at 4 installations has been performed, but the analytical data have not yet been received.

The analytical data, sample tracking information, well status and usage data, and installation POC information is being stored on a computer. A relational database management system is being used for easy retrieval of the information and preparation of reports. Debugging of the automatic reporting system is currently underway.

When complete analytical data for all the wells sampled on an installation have been received, the information will be correlated with any other ground water quality information existing at USAEHA and THAMA. If the SOCS data show no contamination in the drinking water aquifer, or if it confirms existing data, it will simply be forwarded to the installation and Major Army Command (MACOM) for information and filing, and possible use in satisfying EPA drinking water monitoring requirements. If the SOCS data indicate the presence of previously unsuspected contamination, confirmatory sampling will be performed by USAEHA personnel.

Confirmatory sampling will be performed using a bailer whenever access is readily available, instead of the installed water pump. If the contamination

is confirmed, then plans will be developed for further investigations, monitoring, remediation and treatment, using the USAEHA engineers, hydrologists, geologists and THAMA personnel.

RESULTS

Analytical results received to date have been summarized below. Table 2 provides a list of the chemicals which were detected in the samples at levels above the method detection limit, and are presented in order of the frequency of occurrence in the samples. Table 3 presents the same list of chemicals detected, but broken down by chemical class and arranged according to the type of Army installation on which they were found.

TABLE 2. CHEMICALS DETECTED TO DATE DURING SOCS

CHEMICAL	DETECTED CONCENTRATION (ppb) AVERAGE	MEDIAN	RANGE	FREQUENCY OF DETECTION
Dichloromethane	0.69	0.62	0.51 - 1.8	28
Trichlorofluoromethane	1.06	1.09	0.52 - 2.8	26
Trichloroethylene	205.90	5.53	0.88 - 2750.	23
Chloroform	5.22	1.3	0.54 - 32.	22
1,1,1-Trichloroethane	48.80	2.2	0.52 - 394.	15
cis-1,2-Dichloroethylene	9.28	5.0	0.53 - 45.	8
Bromodichloromethane	2.14	1.4	0.98 - 4.9	5
Dibromochloromethane	1.05	0.83	0.61 - 1.8	5
Dichlorodifluoromethane	3.28	0.61	0.51 - 0.92	5
Tetrachloroethylene	2.42	2.0	0.76 - 3.9	4
Carbon tetrachloride	2.49	0.8	0.57 - 7.8	4
Toluene	0.58	0.58	0.54 - 0.63	4
Atrazine	0.44	0.44	0.21 - 0.69	4
RDX	210.		70. - 350.	2
2,4,6-TNT	180.7		1.4 - 360.	2
1,1-Dichloroethylene	18.45		2.9 - 34.	2
2,4-Dinitrotoluene	8.7		5.4 - 12.	2
Xylene	0.79		0.67 - 0.91	2
HMX	103.			1
bis-2-ethylhexyl phthalate	70.			1
Benzene	6.			1
2,6-Dinitrotoluene	2.			1
Naphthalene	1.8			1
Vinyl chloride	1.5			1
1,1-Dichloroethane	0.66			1
1,4-Dichlorobenzene	0.64			1
Chloroethane	0.64			1
Bromoform	0.63			1
1,2-Dibromoethane	0.55			1
Ethylbenzene	0.53			1

The many unknown or tentatively identified chemicals which were detected have not been included on the lists. Efforts are ongoing to better identify these chemicals, either through a more detailed examination of the laboratory data or resampling. The two most frequently detected chemicals, dichloromethane and trichlorofluoromethane, are frequent laboratory contaminants which can be introduced during the analytical process. Further examination of the travel blanks associated with these samples may indicate that the majority of the dichloromethane and trichlorofluoromethane contamination occurred in the laboratory, not the well water.

TABLE 3. CHEMICALS DETECTED AT VARIOUS TYPES OF INSTALLATIONS

	FORSCOM	AMMUNITION PLANTS	DEPOTS	PROVING GROUNDS	ARSENALS
TRIHALOMETHANES					
Bromodichloromethane	X		X		X
Bromoform			X		
Chloroform	X	X	X	X	X
Dibromochloromethane	X		X		X
EXPLOSIVES					
2,4-Dinitrotoluene		X		X	
2,6-Dinitrotoluene		X			
HMX				X	
RDX	X			X	
2,4,6-TNT		X			
HERBICIDES					
Atrazine	X	X	X		
1,2-Dibromoethane				X	
SOLVENTS					
Benzene				X	
Carbon tetrachloride	X				
Chloroethane		X			
1,2-Dibromoethane				X	
1,4-Dichlorobenzene	X				
Dichlorodifluoromethane	X				X
1,1-Dichloroethane			X		
1,1-Dichloroethylene		X		X	
cis-1,2-Dichloroethylene		X	X		X
Dichloromethane	X	X		X	
Ethylbenzene		X			
Tetrachloroethylene	X				X
1,1,1-Trichloroethane	X	X	X	X	X
Trichloroethylene	X	X	X		X
Trichlorofluoromethane	X	X	X	X	X
Toluene				X	
Vinyl chloride		X			
Xylene	X	X			
OTHER					
bis-2-Ethylhexyl phthalate	X				
Naphthalene		X			

The data received to date seem to indicate a few trends in contamination.

a. Table 3 shows that many types of Army installations, at which a wide variety of activities are ongoing, have some contamination by many classes of chemicals. Explosives is the only class of contamination which has so far been limited to only a few types of installations.

b. No pesticides have yet been detected at any Army installations. Only one sample had a low level of contamination with a semivolatile compound.

FUTURE PLANS

The approximately 120 wells which remain to be sampled should be sampled in late FY 89, depending upon the availability of funds. In the meantime, efforts will be focused on:

a. Completing the confirmatory sampling where necessary.

b. Obtaining and compiling complete data for all wells which have been sampled.

c. Completing the ongoing debugging of the computer reporting system.

d. Forwarding completed reports to installations and MACOMs in cases where no contamination is detected.

e. Developing and coordinating further courses of action in cases where chemical contamination has been detected.

f. Performing literature search to determine SOCs for which health criteria or information currently exist. Coordinating with EPA to develop such information if chemicals are detected for which information does not exist.

CONCLUSIONS

Results of the SOCS samples analyzed to date:

a. Confirm reports of contamination from past activities.

b. Show additional contamination sites may exist, in addition to those identified under the THAMA Installation Restoration Program (IRP).

c. Show that pesticide and semivolatile compounds are not usually found in drinking water aquifers at Army installations.

d. Show that explosives are the only type of contaminants found which appear to be limited to a few specific types of Army installations.

e. Show a proactive action and sincere concern on the part of the U.S. Army.

f. Reveal the fine-tuning of analytical methodologies.

g. Provide state-of-the-art baseline data which may be used for many purposes, such as:

(1) Providing accurate information on drinking water quality to the public, which may allay fears sometimes caused by erroneous press.

(2) Fulfilling EPA monitoring requirements.

(3) Examining migration of contaminants if future periodic monitoring is implemented.

h. Provide lessons learned if a similar survey is conducted at OCONUS Army installations in Europe and the Pacific.

ACKNOWLEDGEMENTS

We would like to thank LTC William Hartley, U.S. Army Liaison at EPA; Mr. Andrew Anderson, THAMA; and the USAEHA Analytical Quality Assurance Division for their support.

APPENDIX A

REGULATED SYNTHETIC ORGANIC CHEMICALS

CHEMICAL	CURRENTLY REGULATED[1]	CURRENTLY MONITORED[2]	REGULATE BY 1989[3]	PRIORITY LIST[4]
Acrylamide			-	
Adipates			-	
Alachlor			-	
Aldicarb			-	
Aldicarb sulfone			-	
Aldicarb sulfoxide			-	
Atrazine			-	
Benzene	5			
Bromobenzene		all		-
Bromochloromethane		sd		
Bromodichloromethane	*	all		-
Bromoform	*	all		-
Bromomethane		all		-
n-Butylbenzene		sd		
sec-Butylbenzene		sd		
tert-Butylbenzene		sd		
Carbofuran			-	
Carbon tetrachloride	5			
Chlordane			-	
Chlorobenzene		all	-	
Chloroethane		all		-
Chloroform	*	all		-
Chloromethane		all		-
2-Chlorotoluene (o-)		all		-
4-Chlorotoluene (p-)		all		-
2,4-D			-	
Dalapon			-	
Dibromochloromethane	*	all		-
Dibromochloropropane			-	
1,2-Dibromo-3-chloropropane		sd		
1,2-Dibromoethane (EDB)		sd	-	
Dibromomethane		all		-
Dichlorobenzene			-	
1,2-Dichlorobenzene(o-)		all		
1,3-Dichlorobenzene(m-)		all		
1,4-Dichlorobenzene(p-)	75			
Dichlorodifluoromethane		sd		
1,2-Dichloroethane	5			
1,1-Dichloroethane		all		-
1,1-Dichloroethylene	7			
cis-1,2-Dichloroethylene		all	-	
trans-1,2-Dichloroethylene		all	-	
Dichloromethane		all	-	
1,2-Dichloropropane		all	-	

1,3-Dichloropropane		all		-
2,2-Dichloropropane		all		-
1,1-Dichloropropene		all		-
1,3-Dichloropropene		all		-
2,4-Dinitrotoluene				-
Dinoseb			-	
Diquat			-	
Endothall			-	
Endrin	0.2			
Epichlorohydrin			-	-
Ethylbenzene		all	-	
Glyphosate			-	
Heptachlor			-	-
Heptachlor epoxide			-	
Hexachlorobutadiene		sd		
Hexachlorocyclopentadiene			-	
Isophorone				-
Isopropylbenzene		sd		
p-Isopropyltoluene		sd		
Lindane(gamma BHC)	4			
Methyl tert-butyl ether				-
Methoxychlor	100			
Metolachlor				-
Metribuzin				-
Naphthalene		sd		R
PAH's			-	
Pentachlorophenol			-	
Phthalates			-	
Picloram			-	
PCB's			-	
n-Propylbenzene		sd		
Simazine			-	
Styrene		all		-
2,3,7,8-TCDD(Dioxin)			-	
1,1,1,2-Tetrachloroethane		all		-
1,1,2,2-Tetrachloroethane		all		-
Tetrachloroethylene		all		-
Toluene		all	-	
Toxaphene	5			
2,4,5-T				-
2,4,5-TP			-	
Trichlorobenzene			-	
1,2,3-Trichlorobenzene		sd		-
1,2,4-Trichlorobenzene		sd		
1,1,1-Trichloroethane	200			
1,1,2-Trichloroethane		all	-	-
Trichloroethylene	5			
Trichlorofluoromethane		sd		
1,2,3-Trichloropropane		all		
1,2,3-Trichloropropene				-
Trifluralin				-
1,2,4-Trimethylbenzene		sd		
1,3,5-Trimethylbenzene		sd		
Vinyl chloride	2			

Vydate		-
Xylene (para,meta,ortho)	all	-

Notes:

[1] Currently regulated SOCs. The number in the column represents the MCL in ppb (ug/l).

[2] Currently required to be monitored. "all" indicates that all community and NTNC water systems must monitor for the chemical. "sd" indicates that only water systems which are considered vulnerable or which the State has selected must monitor for the chemical.

[3] SOCs required to be regulated by June 1989 according to the 1986 amendments to the Safe Drinking Water Act, as modified in the 22 January 1988 Federal Register.

[4] First Drinking Water Priority List of chemicals which are known or anticipated to occur in public water systems and which may have an adverse effect on the health of people. "R" indicates a chemical which was considered for the list but was deleted because it is believed there is little or no potential for either adverse health effects or exposure through drinking water.

* MCL for the arithmetic sum of the concentrations of the 4 trihalomethanes = 100 ppb

APPENDIX B

PRELIMINARY LIST OF SOCS CHEMICALS, WITH REVISIONS

CHEMICAL	DW[1]	HW[2]	MIL[3]	METHOD/NOTES
Acenaphthene		-		EPA 625
Acenaphthylene		-		EPA 625
Acrylamide	+			Delete - No method
Adipates	+			Delete - Generic
Alachlor	+			AEHA 33.1
Aldicarb	+			Delete - Not cost effective
Aldicarb sulfone	+			Delete - Not cost effective
Aldicarb sulfoxide	+			Delete - Not cost effective
Aldrin				Detected using EPA 608
Anthracene		-		EPA 625
Atrazine	+			AEHA 33.1
Benzene	+	-		EPA 524.2
Benzidine		-		EPA 625
Benzo(a)anthracene		-		EPA 625
Benzo(a)pyrene		-		EPA 625
Benzo(ghi)perylene		-		EPA 625
Benzo(b)fluoranthene		-		EPA 625
Benzo(k)fluoranthene		-		EPA 625
Alpha BHC				Detected using EPA 608
Beta BHC				Detected using EPA 608
Delta BHC				Detected using EPA 608
Bromobenzene	+			EPA 524.2
Bromochloromethane	+			EPA 524.2
Bromodichloromethane	+	-		EPA 524.2
Bromoform	+	-		EPA 524.2
Bromomethane	+	-		EPA 524.2
4-Bromophenyl phenyl ether		-		EPA 625
n-Butylbenzene	+			EPA 524.2
sec-Butylbenzene	+			EPA 524.2
tert-Butylbenzene	+			EPA 524.2
Butyl benzyl phthalate		-		EPA 625
Carbofuran	+			Delete - not cost effective
Carbon tetrachloride	+	-		EPA 524.2
Chlordane	+			EPA 608
Chlorobenzene	+	-		EPA 524.2
Chloroethane	+	-		EPA 524.2
bis-2-Chloroethoxy methane		-		EPA 625
bis-2-Chloroethyl ether		-		EPA 625
2-Chloroethylvinyl ether		-		EPA 524.2
Chloroform	+	-		EPA 524.2
bis-2-Chloroisopropyl ether	+	-		EPA 625
Chloromethane	+	-		EPA 524.2
4-Chloro-3-methylphenol		-		EPA 625
2-Chloronaphthalene		-		EPA 625

2-Chlorophenol		-		EPA 625
4-Chlorophenyl phenyl ether		-		EPA 625
o-Chlorotoluene	+			EPA 524.2
p-Chlorotoluene	+			EPA 524.2
Chrysene		-		EPA 625
2,4-D	+			SM 509
Dalapon	+			Delete - no capability
DDD				Detected using EPA 608
DDE				Detected using EPA 608
DDT				Detected using EPA 608
Dibenzo(a,h)anthracene		-		EPA 625
Dibromochloromethane		-		EPA 524.2
1,2-Dibromo-3-chloropropane	+			EPA 524.2
1,2-Dibromoethane (EDB)	+			EPA 524.2
Dibromomethane	+			EPA 524.2
1,2-Dichlorobenzene(o-D.)	+	-		EPA 524.2
1,3-Dichlorobenzene(m-D.)	+	-		EPA 524.2
1,4-Dichlorobenzene(p-D.)	+	-		EPA 524.2
3,3'-Dichlorobenzidine		-		EPA 625
Dichlorodifluoromethane	+			EPA 524.2
1,2-Dichloroethane	+	-		EPA 524.2
1,1-Dichloroethane	+	-		EPA 524.2
1,1-Dichloroethylene	+	-		EPA 524.2
cis-1,2-Dichloroethylene	+			EPA 524.2
trans-1,2-Dichloroethylene	+	-		EPA 524.2
Dichloromethane	+	-		EPA 524.2
2,4-Dichlorophenol		-		EPA 625
1,2-Dichloropropane	+	-		EPA 524.2
1,3-Dichloropropane	+			EPA 524.2
2,2-Dichloropropane	+			EPA 524.2
1,1-Dichloropropene	+			EPA 524.2
cis-1,3-dichloropropene		-		EPA 524.2
trans-1,3-dichloropropene		-		EPA 524.2
Dieldrin				Detected using EPA 608
Diethyl phthalate		-		EPA 625
2,4-Dimethylphenol		-		EPA 625
Dimethyl phthalate		-		EPA 625
Di-n-butyl phthalate		-		EPA 625
2,4-Dinitrophenol		-		EPA 625
2,4-Dinitrotoluene		-	#	AEHA 12.1
2,6-Dinitrotoluene		-	#	AEHA 12.1
2,5-Dinitrotoluene			#	Search of EPA 625
2,3-Dinitrotoluene			#	Search of EPA 625
3,5-Dinitrotoluene			#	Search of EPA 625
3,4-Dinitrotoluene			#	Search of EPA 625
Di-n-octyl phthalate		-		EPA 625
Dinoseb	+			Delete - no capability
Diphenylamine			#	Search of EPA 625
1,2-Diphenylhydrazine		-		EPA 625
Dithiane			#	Search of EPA 524.2
Diisopropyl methyl phosphonate			#	Search of EPA 625
Diquat	+			Delete - no method
Endosulfan I				Detected using EPA 608
Endosulfan II				Detected using EPA 608

Endosulfan sulfate				Detected using EPA 608
Endothall	+			Delete - no method
Endrin	+			EPA 608
Endrin aldehyde				Detected using EPA 608
Epichlorohydrin	+			Delete - no method
Ethylbenzene	+	-		EPA 524.2
bis-2-ethylhexyl phthalate		-		EPA 625
Fluoranthene		-		EPA 625
Fluorene		-		EPA 625
Fog oil			#	Search of EPA 625
Glyphosate	+			Delete - no method
Heptachlor	+			EPA 608
Heptachlor epoxide	+			EPA 608
Hexachlorobenzene		-		EPA 625
Hexachlorobutadiene	+	-		EPA 625
Hexachlorocyclopentadiene	+	-		EPA 524.2
Hexachloroethane		-		EPA 625
HMX			#	AEHA 12.1
Hydrocarbon fuels			#	Search of EPA 625
Indeno(1,2,3-cd)pyrene		-		EPA 625
Isophorone		-		EPA 625
Isopropylbenzene	+			EPA 524.2
p-Isopropyltoluene	+			EPA 524.2
Lindane(gamma BHC)	+			EPA 608
2-methyl-4,6-dinitrophenol		-		EPA 625
Methoxychlor	+			EPA 608
Naphthalene	+	-		EPA 524.2
Nitrobenzene		-		EPA 625
Nitroguanidine			#	AEHA-selected sites
2-Nitrophenol		-		EPA 625
4-Nitrophenol		-		EPA 625
n-Nitrosodimethylamine		-		EPA 625
n-Nitrosodi-n-propylamine		-		EPA 625
n-Nitrosodiphenylamine		-		EPA 625
PAH's	+			Delete - Generic
Pentachloroethane	+			Unstable in water
Pentachlorophenol	+	-		EPA 625
Phenanthrene		-		EPA 625
Phenol		-		EPA 625
Phthalates	+			Delete - Generic
Pichloram	+			Delete - no capability
PCB's	+			Delete - Generic
Polychlorinated biphenyls 1016				Added - EPA 608
1221				Added - EPA 608
1232				Added - EPA 608
1242				Added - EPA 608
1248				Added - EPA 608
1254				Added - EPA 608
1260				Added - EPA 608
n-Propylbenzene	+			EPA 524.2
Pyrene		-		EPA 625
RDX			#	AEHA 12.1
Simazine	+			AEHA 33.1
Styrene	+			EPA 524.2

2,3,7,8-TCDD (Dioxin)	+			Only if similar are detected
1,1,1,2 Tetrachloroethane	+			EPA 524.2
1,1,2,2-Tetrachloroethane	+	-		EPA 524.2
Tetrachloroethylene	+	-		EPA 524.2
Tetryl			#	AEHA 12.1
Toluene	+	-		EPA 524.2
Toxaphene	+			EPA 608
2,4,5-T				Detected using SM 509
2,4,5-TP	+			SM 509
1,2,3-Trichlorobenzene	+			EPA 524.2
1,2,4-Trichlorobenzene	+	-		EPA 625
1,1,1-Trichloroethane	+	-		EPA 524.2
1,1,2-Trichloroethane	+	-		EPA 524.2
Trichloroethylene	+	-		EPA 524.2
Trichlorofluoromethane		-		EPA 524.2
2,4,6-Trichlorophenol		-		EPA 625
1,2,3-Trichloropropane	+			EPA 524.2
1,2,4-Trimethylbenzene	+			EPA 524.2
1,3,5-Trimethylbenzene	+			EPA 524.2
1,3,5-Trinitrobenzene			#	Search of EPA 625
Trinitroglycerol			#	AEHA-selected sites
2,4,6-TNT			#	AEHA 12.1
Vinyl chloride	+	-		EPA 524.2
Vydate				Delete - not cost effective
Xylene (para,meta,ortho)	+			EPA 524.2

Notes:

[1] Chemical of concern in drinking water, as listed in Appendix A.
[2] Chemical of concern in Hazardous waste management and is monitored for using EPA Methods 624 and 625.
[3] Military specific chemicals of concern.

DISPOSAL OF
LITHIUM BATTERY

BY

DINKER DESAI
AND
MIKE BRUNDAGE

US ARMY
COMMUNICATIONS
ELECTRONICS COMMAND

MY NAME IS DINKER DESAI. I AM ACCOMPANIED BY MR. BRUNDAGE, CO-AUTHOR OF THIS PAPER.

OUR INTENT IS TO BRIEF YOU ON THE DISPOSAL OF LITHIUM BATTERIES. KEY FEATURE OF THIS PAPER IS THE DEVELOPMENT OF A TECHNIQUE CONVERTING REACTIVE BATTERY INTO NONREACTIVE, HENCE NON-HAZARDOUS, WHICH WILL RESULT INTO SUBSTANTIAL SAVINGS IN DISPOSAL COST FOR THE ARMY. THIS WILL ALSO HELP IN MINIMIZING HAZARDOUS WASTE AT FORT MONMOUTH.

SLIDE I

AT PRESENT, FORT MONMOUTH'S HAZARDOUS WASTE STREAM IS AS FOLLOWS - AS YOU CAN SEE MAJOR PORTION OF HAZARDOUS WASTE IS LITHIUM BATTERIES.

SLIDE II

HQ, AMC HAS TASKED LABCOM WITH BATTERY AND BATTERY CHARGER DEVELOPMENT. LITHIUM IS THE MOST WIDELY USED POWER SOURCE IN THE ARMY. MOST OF THE WASTE GENERATED FROM GOVERNMENT TEST SAMPLES.

SLIDE III

PRESENT EXPERIMENTAL RESULTS INDICATE THAT INTRODUCTION OF SIMPLE RELIABLE COMPONENTS WILL CONVERT REACTIVE BATTERY INTO NON-REACTIVE STATUS. HENCE, WE CAN DISPOSE INTO SECURED SANITARY LANDFILL VS APPROVED HAZARDOUS WASTE SITE.

SLIDE IV

FORT MONMOUTH WILL INCORPORATE THIS RELIABLE COMPONENT WITHIN LITHIUM SULFAR DIOXIDE BATTERIES BEGINNING DEC 88.

SLIDE V AND VI

BY INTRODUCING A COMPLETE DISCHARGE DEVICE, REACTIVITY OF LITHIUM FROM THE BATTERIES WILL BE ELIMINATED. THIS WILL BE ACCOMPLISHED BY ACTIVATING A RESISTIVE LOAD CIRCUIT THROUGH AN INTERNAL MANUAL SWITCH.

SLIDE VII

LABCOM WILL PREPARE A SOP FOR ON SITE ACTIVATING OF SWITCH. AFTER FIVE DAYS, BATTERIES WILL BE DISPOSED OF IN A SECURED SANITARY LANDFILL.

SLIDE VIII

PROJECTED BATTERY USE WILL BE APPROXIMATELY 1.425 MILLION IN 1988-89.

SLIDE VIIII

APPROXIMATELY $6 MILLION DOLLARS WILL BE SAVED. EPA HAS APPROVED THE CONCEPT. USEPA WAS BRIEFED DURING AUG 86, HOWEVER, USEPA WAS NON-COMMITTAL ON THE ISSUE.

SLIDE X

SLIDE X

LABCOM HAS DONE USEPA DEFINED EP TOXICITY TEST ON FULLY DISCHARGED BATTERIES. RESULTS ARE VERY ENCOURAGING.

FORT MONMOUTH HAZARDOUS WASTE STREAM

1.	BATTERY WASTE	LITHIUM MERCURY	40 PERCENT 10 PERCENT
2.	WASTE GENERATED FROM UNDERGROUND STORAGE FAILURE CONSISTS OF HEATING OIL OR GASOLINE.		30 PERCENT
3.	PAINTS		10 PERCENT
4.	SOLVENTS		5 PERCENT
5.	MISCELLANEOUS		5 PERCENT

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ELECTRONICS COMMAND

GENERATOR LABCOM AND CECOM FOR LITHIUM BATTERIES

1. LABCOM TENANT AT FORT MONMOUTH.

2. MISSION: R & D.

3. HQ AMC TASKS LABCOM WITH BATTERY AND BATTERY CHARGER DEVELOPMENT AND ASSIGNMENT.

4. CECOM BUYS SEVERAL HUNDRED THOUSAND LITHIUM BATTERIES EACH YEAR.

5. LITHIUM IS MOST WIDELY USED PORTABLE POWER SOURCE IN THE ARMY.

6. WASTE IS GENERATED VIA GOVERNMENT TEST SAMPLES.

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LABORATORY COMMAND

PURPOSE

- PRESENT EXPERIMENTAL RESULTS OF ARMY'S STUDIES RELATIVE TO DISPOSAL OF LITHIUM SULFUR DIOXIDE BATTERIES IN SANITARY LANDFILLS.

- PRESENT DESIGN MODIFICATION OF BATTERY AND ATTENDANT PROCEDURES FOR DISPOSAL OF LITHIUM SULFUR DIOXIDE BATTERIES IN SANITARY LANDFILLS.

PLAN

ARMY WILL INCORPORATE SIMPLE RELIABLE COMPONENTS WITHIN LITHIUM SULFUR DIOXIDE BATTERIES BEGINNING IN DECEMBER 1988 TO EFFECTIVELY FULLY DISCHARGE THEM AND MAKE THEM DISPOSABLE AS NON-HAZARDOUS WASTE.

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LABORATORY COMMAND

COMPLETE DISCHARGE PROCESS AND VERIFICATION PLAN

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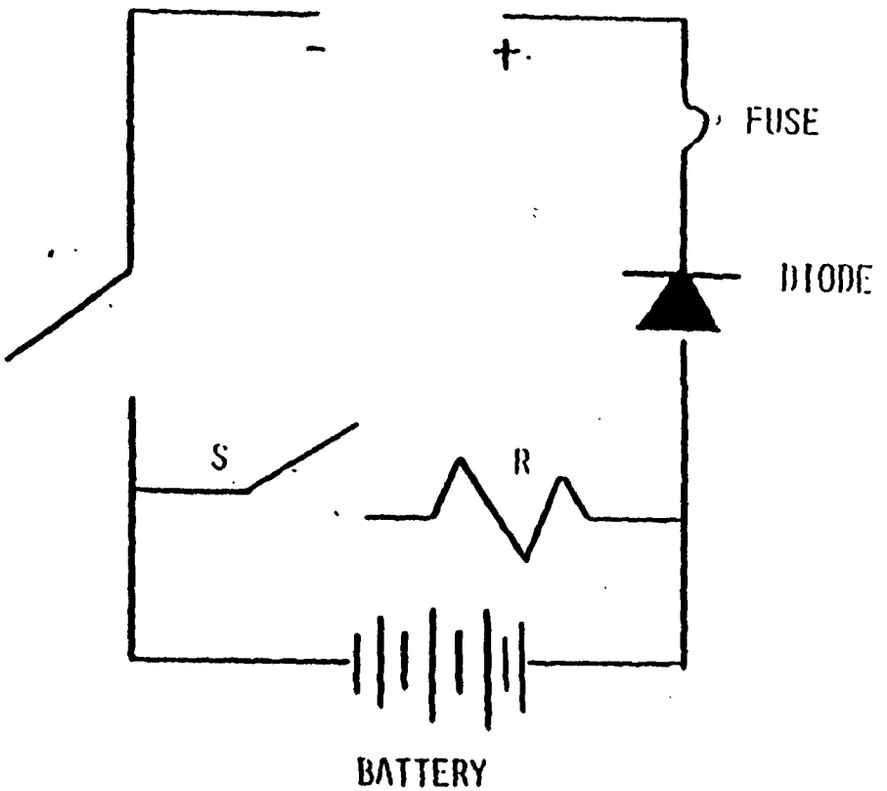
LABORATORY COMMAND

DISCHARGE PROCESS
WIRING SCHEMATIC



S - MANUAL SWITCH
R - RESISTOR

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DISCHARGE VERIFICATION

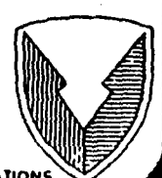
- SOLDIER TURNS IN BATTERIES
- SUPPLY POC ACTIVATES SWITCH
- AFTER 5 DAYS BATTERY IS DISPOSED OF IN SANITARY LANDFILL
- LABCOM WILL SAMPLE FIELD SITES FOR ONE YEAR TO DETERMINE PROCEDURE COMPLIANCE AND INERTNESS OF BATTERIES

PRODUCTION LITHIUM BATTERY STATUS

* USED IN VINSON TEST BED AT FORT BRAGG IN 1975
* IN USE IN ALASKA SINCE 1977
* 9 BATTERY TYPES FIELDED SINCE 1977
* 1 BATTERY TYPE TO BE FIELDED IN 1986

LITHIUM BATTERY PROCUREMENT BY FISCAL YEAR

	ORDERED		PROJECTED MILLIONS
1977	7,031	1986	1,112,400
1978	17,037	1987	80,400
1979	41,356	1988	1,425,000
1980	116,298	1989	
1981	227,650	1990	
1982	361,075	1991	
1983	446,000	1992	
1984	470,000	1993	
1985	2,295,000		



US ARMY
COMMUNICATIONS
ELECTRONICS COMMAND

SEL Form 1105A, 1 Aug 1985

FM 6890-85

COST SAVINGS

A. POTENTIAL COST OF DISPOSAL APPROXIMATELY $5,962,220.00.

B. PRESENT COST AVERAGES $5.50 PER LB. OF BATTERIES - HAZARDOUS

$ .50 PER LB. OF BATTERIES - NON HAZARDOUS

C. EPA'S VIEW:

- BASED ON TECHNIQUE DEVELOPED BY LABCOM
- BATTERIES ARE UNLIKELY TO BE REACTIVE WHEN COMPLETELY DISCHARGED
- ONCE NON-REACTIVE, PROHIBITION OF DISPOSING IN A SANITARY LANDFILL IS NO LONGER NECESSARY.
- BURDEN OF PROOF AS TO SUITABILITY OF BATTERIES FOR LANDFILL DISPOSAL LIES WITH THE GENERATOR OF THE WASTE.

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LABORATORY COMMAND

EP TOXICITY RESULTS ON INTACT CELLS (MG/L)
FULLY DISCHARGED FD (AEHA)

CELL TYPE	CELL CHARGE	ARSENIC	BARIUM	CADMIUM	CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER	NICKEL	COPPER
BA-5567	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	0.86	0.038
	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	0.93	0.038
	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	0.83	<0.025
	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	0.84	0.030
BA-5590	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	3.86	<0.025
	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	4.39	<0.025
	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	4.82	<0.025
	FD	<0.5	<10	<0.1	<0.5	<0.50	<0.02	<0.1	<0.5	3.67	<0.025

US ARMY
LABORATORY COMMAND

CONCLUSION

A FULLY DISCHARGED LITHIUM SULFUR DIOXIDE BATTERY IS NON-HAZARDOUS AND DISPOSABLE IN A SANITARY LANDFILL BASED ON THE FINDINGS PRESENTED HERE AND IN THE AEHA REPORT.